An account of the anatomy of *Clavularia viridis* of Quoy and Gaimard is also given.

This paper will be printed entire in the Society's 'Transactions.'

The following papers were read :—

1. On the Convolutions of the Cerebral Hemispheres in certain Rodents. By Frank E. Beddard, M.A., F.R.S., Prosector to the Society.

[Received December 6, 1892.]

The Rodents are for the most part smooth-brained animals ; there are, however, several exceptions to the universal applicability of this statement, which have been to some extent dealt with by previous writers, including myself. The Rodent brain has not, however, been subjected to that careful study to which the Ungulate and Carnivorous brains have in the hands of Dr. Krueg and Prof. Mivart. The only paper dealing with the Rodent brain in general known to me is by Dareste (1) ; but this article does not include a full description of the convolutions in any type except in the Capybara, though incidental references are made to other types in the author's general survey of the characters of the cerebral hemispheres in the group. Having formed a collection of Rodents' brains during the last year or two from material that came to hand at the Society's Gardens, I think it will perhaps be worth while to again call the attention of anatomists and systematists to the structure of the cerebral convolutions in this group of Mammalia. I have examined specimens of the following species, the brains of which show, at any rate, traces of convolutions :—

Cœlogenys paca.
Dasyprocta azaræ.
Lagostomus trichodactylus.
Capromys pilorides.
Hydrochœrus capybara.
Hystrix cristata.
Sphingurus prehensilis.
—— *villosus.*
Castor canadensis.
Cavia porcellus.
Octodon cummingi.
Myopotamus coypu.
Lepus cuniculus.
Aulacodus swindernianus.
Dolichotis patachonica.

The last two I have lately described in papers dealing with the general anatomy of the Rodents in question (3, 4). Several of these animals have been studied by previous observers; I shall refer to them in the following descriptive part of the present paper.

§ 1. *Description of the Cerebral Hemispheres in certain Genera.*

Castor canadensis[1].—Total length 54 mm., breadth 41 mm., height 25 mm.

The cerebral hemispheres trend away from each other posteriorly, permitting the corpora quadrigemina to be seen; they are closely applied anteriorly. The length of each hemisphere is 38 mm.; the hemispheres are wider behind than in front; the width gradually increases up to a point a little in front of the middle of the hemisphere; thence the two margins are approximately parallel to each other.

The upper surface of the cerebral hemispheres is nearly completely smooth; at about the end of the first half of the hemisphere is a short fissure shaped like the Greek letter γ; behind this, separated from it by a considerable interval and further from the middle line, is a very short (3 mm. long) longitudinal fissure. These two fissures are indicated by Leuret and Gratiolet as forming one continuous fissure. On the under surface of the brain no trace was apparent of the Sylvian fissure. The rhinal fissure is by no means clearly marked; it is only obvious anteriorly and again just before the posterior margin of the hemispheres; it ends at a distance of 15 mm. from the upper surface of the hemispheres. The olfactory bulbs are large.

Capromys pilorides.—Length 38 mm., breadth 26 mm., height 16 mm.

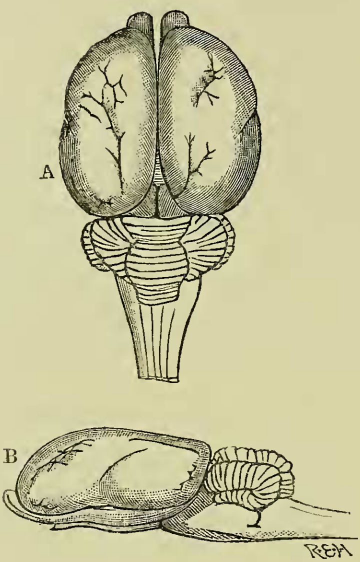
The cerebral hemispheres (fig. 1, p. 598) show the same rounded oval contour that distinguishes the brains of the Porcupines. The extreme diameter of the hemispheres is reached a very short distance behind the anterior end of the brain. The posterior divergence of the two hemispheres partly displays the corpora quadrigemina. Each hemisphere measures 25 mm. in length. The surface is faintly marked by a few furrows. A longitudinal furrow (see woodcut, fig. 1) on each side starts from the inner angle of the hemisphere; it is altogether 9 millimetres long; it passes at first forwards and outwards, and then at the middle of its length changes its direction and runs straight forwards parallel to the long axis of the brain; a very short branch is given off at this point which continues the straight line of the first part of the furrow; another short branch parallel to this is given off on the side just before the end of the furrow. These furrows are more strongly marked on the right half of the brain. In front of this posterior longitudinal furrow is a short C-shaped furrow not connected with it; the concavity of this furrow is directed inwards. There are indications of a very faint transverse furrow at a distance of 10 mm. from the intercerebral sulcus and about 4 mm. from the posterior margin of the brain. A diagonal furrow about 8 mm. in length is partly visible on the sides of the hemispheres when the brain is viewed from above; it

[1] Figured by Leuret and Gratiolet (8, plate ii. fig. 1).

occupies the middle of the length of the hemisphere and runs from above downwards; on the left side of the brain this furrow gives off a faint branch which seems to be the Sylvian fissure—otherwise hardly marked.

On the inferior surface of the brain the rhinal fissure is seen to be

Fig. 1.



Brain of *Capromys pilorides.*

A, from above; B, from the side.

perfectly continuous and quite well marked from end to end. As already mentioned, I found the greatest difficulty in discovering any traces of the Sylvian fissure excepting in the lateral region of the hemispheres, where it is present.

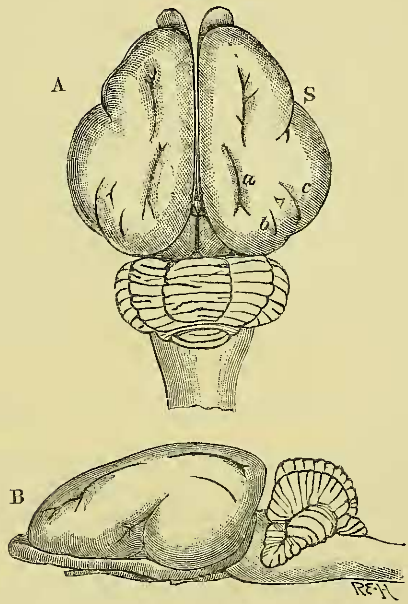
Myopotamus coypu.—Total length 39 mm., breadth 28 mm., height 14 mm.

The cerebral hemispheres are nearly but not quite smooth; there being indications of furrows which are more strongly marked in other genera. The extreme length of each hemisphere is 28 mm. They diverge posteriorly so as to display a portion of the corpora quadrigemina—both nates and testes; the latter are, however, partly concealed by a projection of the cerebellum. Anteriorly the two hemispheres become very narrow and diverge in a marked way from each other; passing back, the hemispheres rapidly increase in breadth until about the middle point, when the margins are nearly parallel, converging slightly posteriorly. The rhinal fissure is quite continuous; the Sylvian fissure is represented by the merest trace. On the upper surface of the brain there are two short furrows on each side, one in front of and to the outside of the other.

Lagostomus trichodactylus.—Total length 43 mm., breadth 35 mm., height 18 mm.

The cerebral hemispheres diverge posteriorly so as to display the corpora quadrigemina; they do not diverge at all anteriorly. The extreme length of each hemisphere is 31 mm. The hemispheres

Fig. 2.



Brain of *Lagostomus trichodactylus.*

A, from above; B, from the side: *a*, *b*, *c*, longitudinal fissures; S, Sylvian fissure. See p. 607.

are wider behind than in front; the breadth increases very gradually up to the Sylvian fissure; at this point the brain suddenly becomes wider.

The brain (fig. 2) is marked by several fairly deep furrows and by other slighter ones. These are perfectly symmetrical. On either side of the intercerebral fissure is a furrow 9 mm. long which commences about 5 mm. from the posterior end of the brain and at about the same distance from the interhemispheral fissure; this furrow is slightly oblique in direction, the anterior end being nearer to the middle line than the posterior. In front of this is another furrow, rather deeper but about the same length; this furrow is twice the distance from the median furrow, that is the last described furrow, and shows a tendency (on one side) to bifurcate anteriorly. If the anterior end of the posterior furrow were bent away from the middle line of the brain, it would come to be continuous with the anterior longitudinal furrow; as it is a space of 3 mm. separates the two. Parallel with the posterior longitudinal furrow are two less conspicuous fissures; they run at about equal distances from each other and from the furrow first described: the inner of the two is only just visible; it is very short and very plainly marked: the outer is 10 mm. in length; it starts from the posterior border of the hemisphere; but the posterior part of this fissure is much shallower than the anterior half, and is indeed only plainly recognizable on the right hemisphere. The Sylvian fissure is very deep on the upper surface of the brain though shallow at its commencement; its direction is on the whole at right angles to the longitudinal axis of the brain; it is, however, curved, the convexity of the curve being forwards; at about the middle of its course it gives off a short forwardly running branch, the direction of which is also slightly downwards.

On the under surface of the brain the only distinct fissure (apart from the Sylvian) to be seen is the rhinal fissure. This is quite obvious from end to end. This fissure can be traced back on the posterior aspect of the hemispheres up to within 6 or 7 mm. of the upper surface of the brain.

Hystrix cristata[1].—Total length 45 mm., breadth 36 mm., height 20 mm.

The cerebral hemispheres are very broad and together have an almost circular contour. They diverge posteriorly so as to reveal the corpora quadrigemina. The upper surface is furrowed to some extent, though not to so marked a degree as in some other genera. The length of each hemisphere is 30 mm.

A longitudinal furrow about 10 mm. long runs on either side of the median furrow on the posterior half of the hemisphere; rather in front of the middle of each hemisphere, this furrow is very nearly continuous with a much deeper furrow passing obliquely outwards at an angle of about 30° with the transverse axis; this furrow, which is about 13 mm. long, is restricted to the dorsal surface of the brain. The remaining furrows are decidedly asymmetrical in their arrangement.

On the left half of the brain there are two downwardly directed fissures running parallel with the Sylvian fissure. On the right

[1] Figured by Leuret and Gratiolet (8, plate iii.).

hemisphere I could only recognize one of these. On the right half of the brain there is a marked indentation to the outside of the posterior extremity of the longitudinal furrow.

On the under surface of the brain the rhinal fissure is seen to be very distinct and complete. The Sylvian fissure is not so distinct where it joins the rhinal fissure as it is laterally; just in front of the Sylvian fissure is a small fissure arising from the rhinal fissure, which appears to be the termination of the anterior transverse fissure of the dorsal surface of the brain.

Sphingurus prehensilis.—Total length 36 mm., breadth 27 mm., height 19 mm.

The cerebral hemispheres show the same peculiar shape that is seen in *Hystrix*; their contour is almost circular; the posterior divergence of the two hemispheres is so nearly filled by the projecting cerebellum that the merest peep at the corpora quadrigemina is alone possible.

Each hemisphere measures 24 mm. in length; the upper surface is smooth, but not so smooth as in the Beaver; it is marked by a good many meandering lines which are for the most part directed downwards. I do not describe these particularly as they do not appear to me to be of any morphological importance. In addition to these there are two dents on the upper surface of the brain. The posterior of these is placed at a distance of about 6 mm. from the hinder margin of the brain; the anterior mark is about the same distance in front.

The rhinal fissure is not well marked, but it is complete. The Sylvian fissure was hardly apparent.

Sphingurus villosus.—Total length 36 mm., breadth 30 mm., height 20 mm.

This brain is almost exactly identical in size with that of the last species; nor is there any occasion to describe the general shape and the proportions of its various regions, for they are precisely as in *Sphingurus prehensilis.*

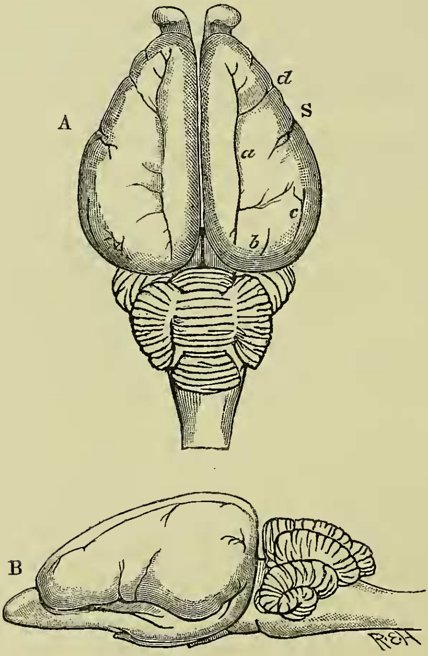
On the other hand, the brain is deeply furrowed in comparison with that of the other *Sphingurus.* It appears to me to be a very remarkable fact there should be this difference in the brain-surface of two animals of the same size and belonging to the same genus. The rhinal fissure is quite deep and perfectly complete. The Sylvian fossa is much deeper than in *Sphingurus prehensilis.* The Sylvian fissure is also quite conspicuous and passes on to the dorsal side of the brain, where it is deeper than at its origin; this region of the Sylvian fissure is represented by the posterior of the two dents upon the surface of the brain of *Sphingurus prehensilis.* In front of this fissure are two others equidistant from it and from each other, which run in a similar direction; besides these principal fissures are numerous smaller ones which are principally branches of them. There was no longitudinal fissure.

Dasyprocta azaræ.—Total length 46 mm., breadth 30 mm., height 20 mm.

The cerebral hemispheres are very closely applied along nearly their whole length; the divergence posteriorly only permits a portion of the anterior pair of corpora quadrigemina to be seen when the brain is viewed from above. Each hemisphere measures 30 mm. in length and is furrowed. The general contour of the hemispheres does not differ from that of the last animal.

The principal furrow (fig. 3) runs longitudinally at a distance

Fig. 3.



Brain of *Dasyprocta azaræ*.

A, from above; B, from the side: *d*, anterior transversely running furrow; S, Sylvian fissure; *a*, *b*, *c*, longitudinal fissures. See p. 607.

of about 5 mm. from the interhemispheral sulcus. It commences close to the posterior margin of the brain and passes nearly as far as the anterior end; at the end of the first third of the total length of the hemisphere this furrow gives off a branch which runs forwards and outwards, joining the rhinal furrow below; 8 mm. behind this point (on the left half of the brain), or 11 mm.

(on the right half), the Sylvian fissure also joins this longitudinally running furrow.

A second longitudinal furrow, at about the same distance from the first described longitudinal furrow as the latter is from the median interhemispheral furrow, and commencing about 5 mm. from the posterior margin of the brain, has a course of 4 or 5 mm.; this furrow is rather more strongly marked on the right half of the brain. Again, to the outside of this is a longer furrow but less strongly marked, which commences at the very margin of the brain just opposite to the point where the rhinal furrow is lost beneath the corpora quadrigemina; this furrow is situated about twice as far from the second longitudinal furrow as that furrow is from the first. Its length is about 12 mm.

On the under surface of the brain the hippocampal gyrus is seen to be very prominent in the temporal region, and when the brain is viewed laterally this convex projection is very apparent. The rhinal fissure is complete and anteriorly appears to give off a short forwardly running branch such as I have described in *Cœlogenys*. The Sylvian fissure is very slightly marked where it joins the rhinal fissure.

The olfactory bulbs are large.

Leuret and Gratiolet's figure (8, pl. iii.), though in my opinion better than that of Owen, is not so clear as the drawing which I exhibit.

Cœlogenys paca.—Total length 53 mm., breadth 42 mm., height 23 mm.

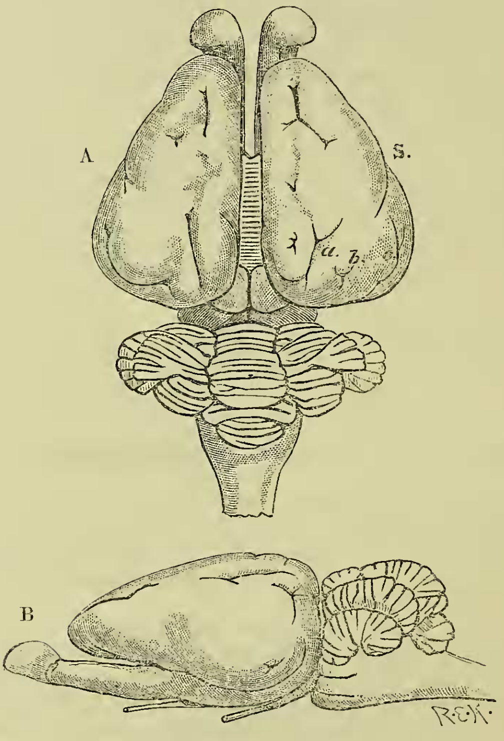
The cerebral hemispheres diverge posteriorly so as to display the corpora quadrigemina; there is no divergence anteriorly. Each hemisphere measures 34 mm. in length and is considerably wider behind than in front, the diameter increases more rapidly after the Sylvian fissure.

The surface of the hemispheres (fig. 4, p. 604) is indented by a few very deep furrows, which are quite symmetrically arranged. A furrow 10 mm. long lies posteriorly at a distance of 7 mm. from the interhemispheral sulcus; anteriorly there is a shorter furrow which suddenly bends outwards posteriorly and runs almost parallel with the margin of the hemisphere. The posterior furrow is continued forward by a very faintly marked furrow which approaches the middle line and then turns outwards, joining or running just behind the end of the anterior furrow. On the right side of the body there is a small but deep indentation on the inner side of the posterior furrow, between it and the interhemispheral furrow; there is also (on both sides of the brain) another dint—it is hardly long enough to be called a furrow—on a level with the hind extremity of the posterior furrow and about as far from it as that furrow is from the median interhemispheral sulcus.

Outside this again is a shallow furrow which begins at the posterior margin of the hemisphere, just on a level with the end of the rhinal furrow (on the right side); its course is longitudinal, but at an angle of about 30° with the longitudinal axis.

On the under surface the rhinal fissure is complete and very deep and wide; on the hinder aspect of the brain it is seen to reach to within about 12 mm. of the inner corner of the hemisphere;

Fig. 4.



Brain of *Cœlogenys paca.*

A, from above; B, from the side: S, Sylvian fissure; *a*, *b*, *c*, longitudinal fissures.

anteriorly the under surface of the pallium is marked by a short but deepish fissure which appears to become continuous with the rhinal fissure, but is really, in all probability, a distinct longitudinal groove upon the lower surface of the pallium. The hippocampal lobe is marked by an indentation just on a level with the Sylvian fissure; there are also faint transverse lines in front of this. The Sylvian fissure is represented by a mere notch, more emphasized on the right half of the brain than on the left.

The olfactory bulbs are large.

The brain of this animal is also figured by Leuret and Gratiolet (8, pl. iii.). The furrows are not, however, sufficiently marked in their drawing.

Cavia porcellus.—Length 28 mm., breadth 20 mm., height 12 mm.

The description of this brain need not occupy us long, since the convolutions upon the cerebral hemispheres are very greatly reduced as compared with allied forms. The outline of each hemisphere, which measures 20 mm. in extreme length, is roughly triangular; the widest point is not far in front of the posterior margin of the hemispheres; thence the opposite margins converge to the anterior end of the brain, which is of slight diameter. The hemispheres are divaricated behind so as to display the corpora quadrigemina.

On the under surface the rhinal fissure is well marked, entirely separating the rhinencephalon from the pallium; this fissure is considerably deeper behind than in front. In the temporal region the rhinencephalon is very convex, a more or less strongly marked fissure (the Sylvian fossa) separating the convex posterior from the more flattened anterior part of the rhinencephalon. The rhinencephalon is visible when the brain is viewed laterally. On the left side there is a distinct Sylvian fissure, which extends for a distance of about 6 mm.; its direction is almost vertical, but it slopes backwards a little. On the right side of the brain there was no trace that I could see of this fissure.

The upper surface of the brain is but little fissured. On each hemisphere is a short fissure about 5 mm. long commencing a little way in front of the posterior margin of the brain and situated 3 mm. from the median interhemispheral fissure; in addition to this another longitudinal fissure is present on each side 5 mm. away from the last, longer and commencing at the posterior margin. This fissure is, however, even shallower than the last, but in spite of this is perfectly evident.

It is generally stated that the convolutions of the hemispheres bear some relation to the size of the animal; thus in relation to the Cervidæ Sir W. H. Flower has pointed out[1] "how closely the amount of convolution bears relation to the bulk of the hemisphere, the primitive pattern being exactly the same in all." Again, among the Primates the Marmoset has the tiniest brain, and this brain is quite smooth. Broadly speaking the rodents form no exception to this generalization; its truth becomes more apparent when the comparisons of extent of complication of brain-surface are restricted to a family rather than when applied to the whole group.

Otherwise the brain of the Beaver forms a marked exception; it is as large as any rodent brain excepting *Hydrochœrus* and is nearly perfectly smooth, while considerably smaller brains, such as *Lagostomus*, are decidedly convoluted.

The above-given account of the various brains which I have been

[1] 7, p. 174.

able to examine leads me to disagree with some of the statements in Dareste's paper (1). After describing the convolutions of the Capybara he remarks :—"Il n'existe point dans les autres Rongeurs de véritables circonvolutions ; mais les anfractuosités et les depressions que l'on observe à la surface du cerveau de leurs grandes espèces sont manifestement, dans leur disposition, l'ébauche et comme l'indication des circonvolutions si développées et si nettement dessinées du Cabiai." Sir William Turner also, in his interesting survey of the Mammalian brain (2), says upon the same subject :— "The Rodentia are almost universally smooth-brained. But in some genera traces of shallow fissures may occasionally be seen on the surface which indicate an early stage in the formation of convolutions." It appears to me that both these statements underestimate the actual development of fissures and convolutions [1] upon the brain of the larger Rodents. I do not, I confess, see any reason for M. Dareste's distinction between the "circonvolutions" of the brain of *Hydrochœrus* and the "anfractuosités" of the brains of some other forms ; perhaps, however, Dareste had not in his hands such well-preserved brains as I have been able, thanks to the skill of my assistant Mr. Ockenden, to examine. Judging from a specimen of the brain of *Hydrochœrus* which I have seen by the kindness of Mr. Charles Stewart in the Museum of the Royal College of Surgeons, the fissures in this rodent are not more marked than they are in, for example, *Lagostomus* ; but the latter is one of the best developed brains in this respect, and it is one of the types which M. Dareste did not examine or refer to ; I should, however, dispute his statement even when applied to the Agouti ; I think that a comparison of my figure of the brain of this rodent with M. Dareste's figures of the brain of *Hydrochœrus* will bear out my remarks.

Another point in which I find myself in disagreement with M. Dareste concerns the Sylvian fissure. He remarks, and judging from his figure with perfect truth, that the Capybara has no fissure in its brain which can be compared to this universally present fissure ; it is, however, a little rash to found upon the examination of a single type (he says nothing in this matter of the other Rodents' brains) a generalization of so much importance as that which Dareste proceeds to formulate, viz. :—"Le cerveau des Rongeurs nous présente, selon toute apparence, un type distinct de celui des Primates, des Carnivores et des Ruminants ; type principalement caracterisée par l'absence de la scissure de Sylvius, et par suite par l'absence de la division du cerveau des deux lobes, l'un antérieur, l'autre postérieur à la scissure." Sir W. Turner also remarks that "The Sylvian fissure . . . is not seen . . . in the lissencephalous Rodents." The Sylvian fissure is undoubtedly feebly developed in the majority of those Rodents [2] the brains of which I have personally

[1] Leuret and Gratiolet head plate iii., on which Rodents' brains are figured, with the title "Encéphale des Mammifères dont les lobes cérébraux sont dépourvus de circonvolutions."

[2] The Sylvian fissure also exists in a few perfectly smooth-brained Rodents for instance in the following :—*Sciurus*, *Dipus*, *Gerbillus*, *Chinchilla*.

studied; but it is quite impossible to characterize the group by the absence of this fissure; for instance, there is a distinct trace of this fissure in *Cœlogenys* and in *Capromys*; *Dasyprocta* has quite a respectable Sylvian fissure, though, as I have already pointed out, it is not thoroughly certain which of the two fissures to be found in this neighbourhood is to be compared with the Sylvian fissure of other Mammals; but the best exception to M. Dareste's unfortunate generalization is shown by the genus *Lagostomus*, where the Sylvian fissure is so deep and extensive that it could not possibly be overlooked, and moreover appears on the dorsal aspect of the brain, as shown in the drawing which I have already exhibited (fig. 2, p. 599). I do not think it worth while to follow M. Dareste into his comparison of the Rodent brain with that of the Marsupials and more particularly of the Kangaroo; he chiefly bases this comparison upon the supposed absence of the Sylvian fissure in the latter animal, a supposition which is not true (see for example the woodcut (fig. ii.) illustrating Sir William Turner's paper upon the mammalian brain).

§ 2. *Comparison of the Brains of the Genera described* inter se.

The convolutions of the Rodent's brain can be satisfactorily compared; but unfortunately most genera have small brains which either show no traces of any furrows or only traces. The furrows are, however, well developed in *Cœlogenys*, *Dasyprocta*, *Dolichotis*, *Lagostomus*, and *Hystrix*; traces of the more important furrows can be recognized in *Castor*, *Aulacodus*, *Capromys*, *Sphingurus*, *Myopotamus*, *Lepus*, *Cavia*, and *Octodon*; the brains of *Sciurus*, *Dipus*, *Gerbillus*, and *Cricetus* are quite smooth.

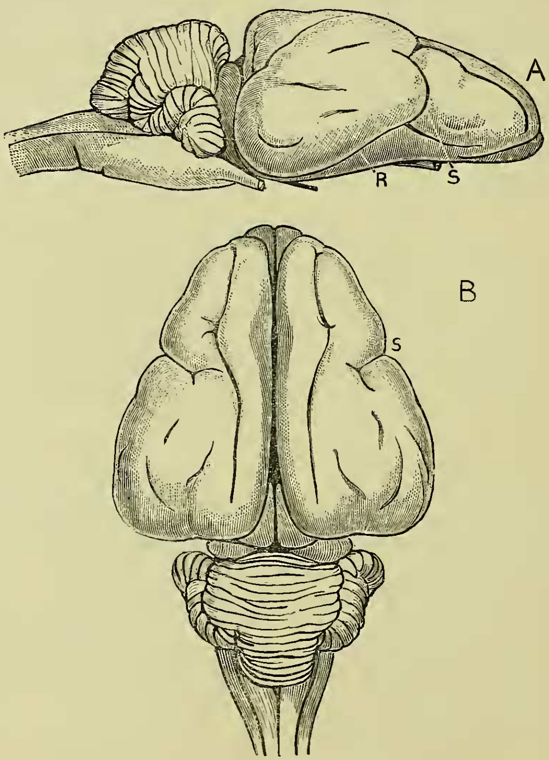
The brain of *Dasyprocta* is a convenient starting-point; I shall therefore briefly recur to the furrows which mark the cerebral hemispheres of this Rodent. I do not propose to call these furrows by any names, for that would imply a direct comparison with the similarly named furrows in the brains of other Mammalia; I doubt very much how far such comparisons can be safely made. Each hemisphere has five furrows (apart from the "rhinal" furrow, which I leave aside for the present), three of which run parallel with the long axis of the brain and two somewhat transversely to that axis.

The most important of these furrows (*a*, see figs. 2, 3, & 4, pp. 599, 602, 604) runs at a distance of about 5 mm. from the interhemispheral sulcus nearly from end to end of the brain. The second longitudinal furrow (*b*) is very short, about 5 mm. long, and about 5 mm. distance from *a*. The third longitudinal furrow (*c*) is about twice the length of the last, and is situated about midway between the dorsal and ventral surfaces of the brain when the brain is seen in profile. At the end of the first third of the hemisphere the furrow *a* gives off a transverse furrow (*d*), which joins the rhinal fissure; behind this, at the end of the second third, is a second transverse fissure which joins *a* on one side only, and separates the temporal from the frontal lobe; I have no hesitation in terming this the Sylvian fissure.

In the brain of *Lagostomus* (fig. 2, p. 599) the same fissures are present, but differently developed; *a* is broken into two separate fissures on each side, *b* has almost disappeared, *c* is also rudimentary; between *b* and *c* is a short fissure *b′* which seems to be unrepresented in *Dasyprocta*; of the transverse furrows *d* is only just indicated at its junction with *a*, while the Sylvian fissure is very deep and does not nearly reach *a*.

In *Dolichotis* (fig. 5) *a* is even longer and stronger than in

Fig. 5.



Brain of *Dolichotis patagonica*.

A, from the side; B, from above: S, Sylvian fissure; R, rhinal fissure.

Dasyprocta; *b* is not parallel to *a*, but converges towards it anteriorly; *b* is well developed and consists of two separated portions; *c* is fully developed; the only trace of *d* is a bend in the furrow *a* at the point where *d* would join it were that furrow present ; the Sylvian fissure is deep and bifurcate at the upper end, nearly joining *a*.

Cœlogenys (fig. 4, p. 604) has a less convoluted brain. The fissure *a* is divided into two quite separate portions, which occupy the first and last thirds of the hemisphere; *b* is merely a deep dent which is rather transverse in direction, running towards *c*: neither *d* nor the Sylvian fissure was well developed ; on one side, however, the latter could be made out, and there were indications of *d* as a deepish depression connected by a shallow furrow with the end of the first part of *a*.

In *Hystrix a* is not extensive; fissures which possibly correspond to *b* and *c* are present but run obliquely outwards; *c* and *d* are well developed, so that altogether the furrows have a markedly oblique disposition.

In the smaller brains *a* is, as in the larger brains, the most important fissure upon the upper side of the brain. It is the only one present in *Octodon* and *Myopotamus*.

§ 3. *The Structure of the Hemispheres and the Classification of the Rodentia.*

It is not my object here to enter into any detailed account of the various ways in which this group of Mammals has been arranged by various authorities; I shall only point out how far the results which I have been able to get together affect the scheme of classification propounded by the late Mr. Alston. This naturalist divided, it will be recollected, the Order Rodentia into three groups:—(1) HEBEDENTATI ; (2) SIMPLICIDENTATI ; (3) DUPLICIDENTATI. We are here only concerned with the last of the three groups, which are separated by Alston into a number of families.

The following are the families of which I have personally examined brains, with the genera which I have examined:—

(1) SCIUROMORPHA.
- *Sciurus.*
- *Castor.*

(2) MYOMORPHA.
- *Gerbillus.*
- *Cricetus.*
- *Dipus.*

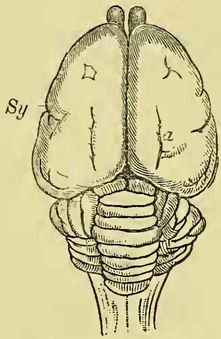
(3) HYSTRICOMORPHA.
- *a.* Octodontidæ.
  - *Octodon.*
  - *Myopotamus.*
  - *Capromys.*
  - *Aulacodus.*
- *b.* Hystricidæ.
  - *Hystrix.*
  - *Sphingurus.*
- *c.* Chinchillidæ.
  - *Lagostomus.*
  - *Chinchilla.*

d. Dasyproctidæ.
Dasyprocta.
Cœlogenys.
e. Caviidæ.
Cavia.
Dolichotis.
Hydrochœrus.

It will be noticed at once that the convoluted brains belong to the last of the three divisions of the Simplicidentati; the obscure dints upon the upper surface of the cerebrum of the Beaver are apparently the only apology for convolutions possessed by either the Sciuromorpha or the Myomorpha. In point of size there is every reason why some of the members of these two groups should have recognizable convolutions; apart from the Beaver, which is one of the largest of the Rodentia, there is the Common Squirrel, whose brain is distinctly bigger than that of *Octodon*, in which genus there are decided traces of convolutions; it seems to me therefore that—for the present at least—we may regard these two groups of the Simplicidentati as being characterized by the entire absence of convolutions. It is quite otherwise with the Hystricomorpha; the larger members of this group show convolutions which can be reduced to a common plan. But there are differences among the genera which permit of an arrangement in accordance with the varying condition of the convolutions. The Hystricidæ form a perfectly natural family. Their brain is characterized by its peculiar shape, rounded in front, and by the fact that the convolutions for the most part are transverse and not longitudinal in direction. Only in *Hystrix* itself is the principal longitudinal furrow *a*, which occurs in all other Rodents whose brains show any convolutions at all, represented to any extent. In relation to this fact it may be pointed out that we may fairly regard *Hystrix* as the least specialized of the Rodents whose brains are treated of here. The only animal whose brain approaches that of the Porcupines is, as I have already pointed out, *Capromys*; the brain of this Rodent is rounded off in the same way anteriorly. The convolutions are so feebly developed that the comparison can perhaps hardly be pushed any further. It may, however, be worth remarking that a lateral furrow, which I regard as being a part of the Sylvian fissure, is well marked both in *Capromys* and in the Porcupine. This latter furrow is also not inconspicuous in *Aulacodus* (fig. 6, p. 611), the relationships of which to *Capromys* are apparent from a comparison of their brains. Even in *Myopotamus*, where the shape of the brain is very different from that of other Octodontidæ, there is a distinct trace of the lateral oblique furrow which is so well marked in both *Aulacodus* and *Capromys*. In any case, therefore, the naturalism of the family Octodontidæ is shown by a comparison of their brains. We next come to the Dasyproctidæ, represented by the two genera *Dasyprocta* and *Cœlogenys*. Of these two brains *Cœlogenys* is the larger, and yet it has the fewest furrows;

these furrows are, however, deeper than in *Dasyprocta*. The chief point of agreement between them, and that which causes them to differ from the two remaining families, is the absence of the Sylvian fissure; this brings *Hydrochœrus* into relation rather with the Dasyproctidæ than the Caviidæ, where it is placed by Alston. Judging also from Dareste's figure, the general outline of the brain of *Hydrochœrus* is like that of *Cœlogenys*, but also of *Lagostomus*. In all these three genera the principal longitudinal fissure, which I have called "*a*," is divided into two portions, one anterior and one posterior. Apart

Fig. 6.



Brain of *Aulacodus*, viewed from above.
Sy, Sylvian fissure; *a*, longitudinal furrow.

from this the brain of *Lagostomus* appears to be nearer to that of *Dolichotis*. They have both of them a deep Sylvian fissure, and the furrows *b* and *c* tend to converge towards the middle line; finally, the rhinal fissure in both genera is deeper behind than in front. I have not ventured to treat at length of the evidences of affinity afforded by the convolutions, since the illustrations are before the reader, who can form his own opinions.

List of Papers and Books referred to.

(1) Dareste, C.—"Note sur le Cerveau des Rongeurs et particulièrement sur le Cerveau du Cabiai," Ann. Sci. Nat. sér. 4, vol. iii. (1855), p. 355, pl. xi.

(2) Turner, Sir W.—"The Convolutions of the Brain: A Study in Comparative Anatomy," J. Anat. Phys. vol. xxv. pp. 105–153 (1891).

(3) Beddard, F. E.—"Notes on the Anatomy of *Dolichotis patagonica*," P. Z. S. 1891, p. 236.

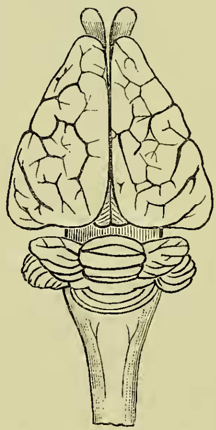
(4) Beddard, F. E.—"On the Brain and Muscular Anatomy of *Aulacodus*," P. Z. S. 1892, p. 520.

(5) Mivart, St. George.—"Notes on the Anatomy of *Erithizon dorsatus*," P. Z. S. 1882, p. 271.

(6) Owen, Sir R.—'Comparative Anatomy and Physiology of Vertebrates.'
(7) Flower, Sir W. H.—"On the Structure and Affinities of the Musk-Deer (*Moschus moschiferus*, Linn.)," P. Z. S. 1875, p. 159.
(8) Leuret, F., & Gratiolet, P.—'Anatomie comparée du Système nerveux.' Paris, 1839–1857.
(9) Alston, E. R.—"On the Classification of the Order Glires," P. Z. S. 1876, p. 61.

P.S. (December 29th, 1892).—I am indebted to the kindness of Prof. Howes for the opportunity of figuring (fig. 7) and describing a most remarkable Rabbit's brain. The animal was

Fig. 7.



Brain of Rabbit, showing abnormal development of convolutions.

a domesticated Rabbit, and was dissected in the laboratory of the Royal College of Science by one of Prof. Howes's students. Ordinarily the brain of this Rodent has but one slightly marked furrow upon the upper surface of each hemisphere, which corresponds to that lettered *a* in the series of woodcuts which illustrate this paper. In the brain before me this furrow is present, but it is continuous from one end of the brain to the other, having a somewhat zigzag course; at the angles formed by the zigzags of furrow *a* a number of transverse furrows are given off, which for the most part reach the under surface of the cerebrum joining the rhinal fissure. In addition to these (of which one seems to correspond to the Sylvian